

The association of adakite with Cu (Au) deposits

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Copper deposits are usually associated with high fO_2 rocks in subduction settings [1, 2], in particular, adakite [3]. This was attributed to that adakite is essential for the elevated fO_2 [4]. High fO_2 of subduction released fluids [5], however, argues strongly against this model. Given that Cu is a moderately incompatible element [6], the oceanic crust has Cu >2 times higher than the mantle wedge, therefore, "primitive" adakites that result from slab melting should contain higher Cu than those from normal arc rocks. This simple argument however, is not supported by a globally compiled dataset showing that Cu concentrations of adakites are generally lower than those of normal arc rocks. This is due to Cu loss during magma differentiation by crystallization of Fe-Ti oxides [7]. The occurrence of slab-derived adakites that can release larger amounts of Cu (Au) by crystal fractionation leads to higher potential for Cu (Au) mineralization at the convergent margins. Normal arc magmas may also release Cu through differentiation and thus well contribute to Cu mineralization especially for epithermal ore formation. Slab melts play a crucial role particularly in the closed magma system responsible for generating porphyry Cu deposits. Adakites may also form by partial melting of the lower part of thickened continental crust [8, 9]. These two types of adakites can be discriminated geochemically, e.g., using a combination of Sr/Y, MgO and Na₂O contents, and Sr-Nd isotopes, in addition to their association with Cu deposits.

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Mobile gold in soil

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Ionic Gold in Soil

For the first time, we have mapped the presence of ionic gold in soil. Natural soil samples containing pedogenic calcrete, from a soil profile overlying a Au deposit in Western Australia, were investigated for their Au content using ICP-MS and LA-ICP-MS. We used synchrotron X-ray fluorescence and GeoPIXE software to reveal the distribution of Au in a polished specimen of the soil. X-ray adsorption near edge spectrometry indicated that a significant proportion of the Au was in an ionic form, most likely as Au (I), and correlated with Br. The remaining Au was as nanoparticles. Most of the ionic Au appeared to have accumulated in a root void. There was no association between Au and Ca at the specimen scale even though a strong correlation exists between Au and the alkaline earth elements in the soil profile. Tests on bulk soil samples from the profile indicate that up to 20% of the Au present was water soluble and thus potentially mobile.

Discussion

Evidence for soluble Au in soil has been known for many years [1] and the possible role of mobile colloidal Au and organically-complexed Au has been previously discussed [2, 3]. However, it has been unclear whether Au naturally occurs in ionic form or is dissolved by a substance in the soil (like cyanide or organic acids) that was first mobilised. We show for the first time that ionic Au is present in the soil samples and is the most likely Au to be dissolved by water. The results also indicate that Au may be subject to biological influences. Plants readily take up Au and accumulate it within their tissue and our results show that in the rhizosphere specific reactions are taking place which influence the mobility of Au. The ability of Au to be mobilised in the soil is contrary to traditional views of it being a relatively inert metal.

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